8.2 Graphing $f(x) = ax^2 + c$

Learning Target:

- How does the value of c affect the graph of $f(x) = ax^2 + c$?

Success Criteria:

- I can graph quadratic functions of the form $f(x) = ax^2 + c$.
- I can solve real-life problems involving functions of the form $f(x) = ax^2 + c$.

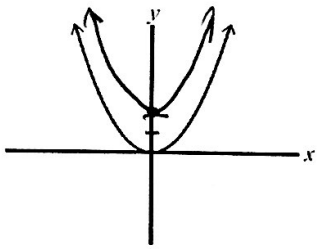
I can graph quadratic functions of the form $f(x) = ax^2 + c$

Intro Problem #1 How does the value c in the equation $y = x^2 + c$ affect the graph of the equation $y = x^2$?

Exploration:

1) Make a conjecture about how the graph of the equation $y = x^2 + 2$ would be different from the graph of the equation $y = x^2$. move up 2 units

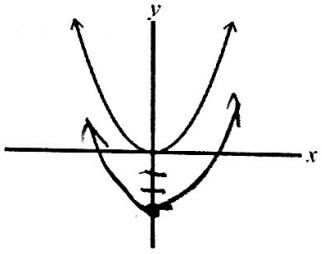
2) Test your conjecture by graphing $y = x^2$ and $y = x^2 + 2$ at the same time on a graphing calculator. (Use the standard window by pressing ZOOM, then ZStandard). Sketch the graph of $y = x^2 + 2$ on the graph at the right . Describe the differences between the graphs of $y = x^2$ and $y = x^2 + 2$.



moves up 2 units (vertical shift)

3) Make a conjecture about how the graph of the equation $y = x^2 - 3$ would be different from the graph of the equation $y = x^2$. down 3 units (vertical shift)

4) Test your conjecture by graph $y = x^2$ and $y = x^2 - 3$ at the same time on a graphing calculator. (Use the standard window by pressing ZOOM, then ZStandard). Sketch the graph of $y = x^2 - 3$ on the graph at the right. Describe the differences between the graphs of $y = x^2$ and $y = x^2 + 2$.



down 3 units. (vertical shift)

8.2 Graphing $f(x) = ax^2 + c$

Observations:

When a constant value is added to the x^2 in the equation $y = x^2$, in other words when $c > 0$ in the equation $y = x^2 + c$, the graph of the equation $y = x^2$ will shift up by c units.

This is called a vertical translation upward.

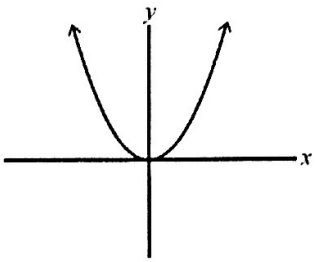
When a constant value is subtracted from the x^2 in the equation $y = x^2$, in other words when $c < 0$ in the equation $y = x^2 + c$, the graph of the equation $y = x^2$ will shift down by c units.

This is called a vertical translation downward.

Summary

When $c > 0$, the parabola for $y = ax^2$ will be shifted UP by c units.

When $c < 0$, the parabola for $y = ax^2$ will be shifted DOWN by c units.



Remember: A parabola is the graph of a quadratic function.

Example 1: Without graphing, predict the following about the graph of $y = -\frac{1}{2}x^2 + 3$.

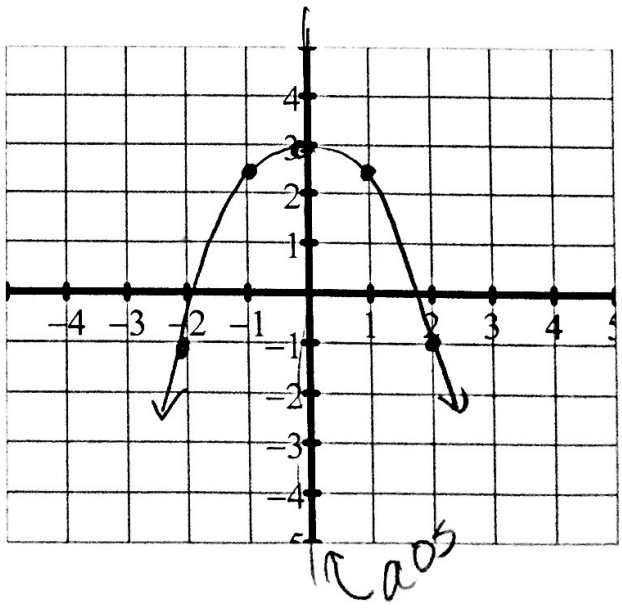
Will the parabola graph be narrower or will it be wider than the graph of $y = x^2$? wider

Will the parabola graph open upward $\cup$ or open downward $\cap$? ($a < 0$)

Will the parabola graph be shifted up or down at all? If so, how many units? up 3 units

Now graph the equation $y = -\frac{1}{2}x^2 + 3$ using a table of ordered pair solutions.

x	$y = -\frac{1}{2}x^2 + 3$	y
-2	$y = -\frac{1}{2}(-2)^2 + 3$	-1
-1	$y = -\frac{1}{2}(-1)^2 + 3$	2.5
0	$y = -\frac{1}{2}(0)^2 + 3$	3
1	$y = -\frac{1}{2}(1)^2 + 3$	2.5
2	$y = -\frac{1}{2}(2) + 3$	-1



8.2 Graphing $f(x) = ax^2 + c$

What are the coordinates of the vertex? (0, 3)

Is the vertex the Maximum point or the Minimum point of the graph? Maximum

Draw a dark dotted line for the axis of symmetry, then give the equation of this line: $x = 0$

Use the graph to find or estimate the zeros of the equation: $x = -1.75$ and $x = 1.75$ (approximate)

Use the graph to find the Domain and the Range for the equation.

Domain: $x \in \mathbb{R}$ Range: $y \leq 3$

For $x < 0$, is the graph increasing or is it decreasing?

For $x > 0$, is the graph increasing or is it decreasing?

You try: Without graphing, predict the following about the graph of $y = 3x^2 - 4$

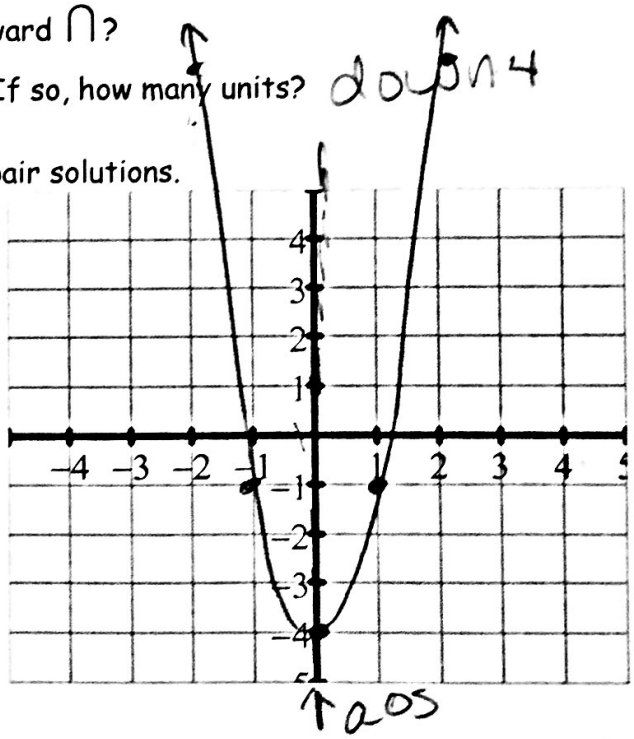
Will the parabola graph be narrower or will it be wider than the graph of $y = x^2$? wider

Will the parabola graph open upward ∪ or open downward ∩?

Will the parabola graph be shifted up or down at all? If so, how many units? down 4

Graph the equation $y = 3x^2 - 4$ using a table of ordered pair solutions.

x	$y = 3x^2 - 4$	y
-2	$3(-2)^2 - 4 = 3(4) - 4 = 12 - 4 =$	8
-1	$3(-1)^2 - 4 = 3 - 4 =$	-1
0	$3(0)^2 - 4$	-4
1	$3(1)^2 - 4 = 3 - 4 =$	-1
2	$3(2)^2 - 4 = 3(4) - 4 = 12 - 4$	8



What are the coordinates of the vertex? (0, −4)

Is the vertex the Maximum point or the Minimum point of the graph? (lowest point)

Draw a dark dotted line for the axis of symmetry, then give the equation of this line: $x = 0$

Use the graph to find or estimate the zeros of the equation: $x = -1.25$ and $x = 1.25$

approximate

8.2 Graphing $f(x) = ax^2 + c$

Use the graph to find the Domain and the Range for the equation.

Domain: $X \in \mathbb{R}$ Range: $y \geq -4$

For $x < 0$, is the graph increasing or is it decreasing?

For $x > 0$, is the graph increasing or is it decreasing?

Example 2: Graphically find the zeros (which are also the x-intercepts of the graph) for each function.
Hint: Use your calculator. (estimate from the graph on your calculator)

Example: $y = 4x^2 - 36$ $X = 3$ $X = -3$

You try: $f(x) = -8x^2 + 8$ $X = 1$ $X = -1$

I can solve real-life problems involving functions of the form $f(x) = ax^2 + c$.

Example3: Modeling with Mathematics. The function $y = -16x^2 + 36$ represents the height (in feet) of an apple x seconds after falling from a tree. Find and interpret the $x-$ and $y-$ intercepts.

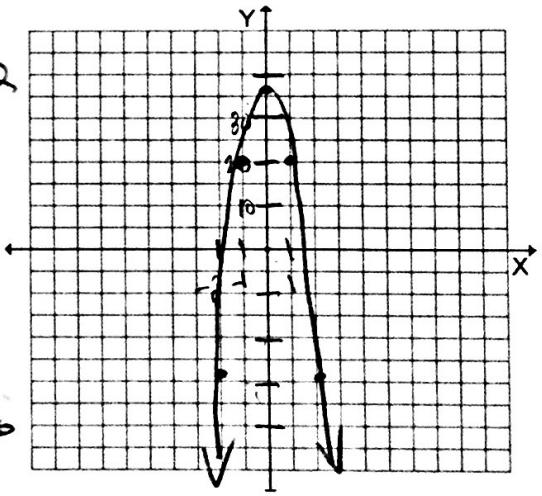
X-intercepts: Graph : opens down
- narrower than $y=x^2$
- shifted up 36

aos: $x=0$

X	y
-2	-28
-1	20
0	36
1	20
2	-28

Estimate X-intercepts: $X = \pm 1.5$

y-intercept: $y = 36$



Closure: What I learned today was…..